Motivation and Its Regulation

The Control Within

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No Pain, No Gain

How Distress Underlies Effective Self-control (and Unites Diverse Social Psychological Phenomena)

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Let's dispense with the obvious: Pain is painful. Pain is the unpleasant experience associated with actual or potential tissue damage. In its social form, pain is the unpleasant experience associated with actual or potential damage to social relationships. Pain is thus related to physical and social damage and recruits unpleasant feelings and sensations. As such, people go to great lengths to avoid pain, for example, staying away from burning elements, steering clear of mean people, and steering clear of mean people near burning elements. Pain is thus adaptive, motivating people to withdraw from damaging situations and to avoid similar situations in the future.

Just as with pain, distress is painful, albeit adaptive. Distress, or anxiety, describes the unpleasant experience that occurs when things have not gone as planned; or when there is potential for things not to go as planned. Because it is unpleasant, people are motivated to avoid distress and to learn from it via the mechanics of negative reinforcement learning. Distress alerts people to the possibility that their goals are at risk of not being met and in so doing arouses shifts in behavior from routine and automatic to deliberate and controlled (Norman & Shallice, 1986). The main point of this chapter is to suggest that, just as with pain, distress inspires people to engage self-control to remediate situations

where things have actually or potentially gone awry. We further want to suggest that this distress-control dynamic underlies–and potentially unites–a number of seemingly diverse social-psychological phenomena.

BRIEF OVERVIEW

Self-control refers to the mental capacity individuals use to influence their own thoughts, emotions, and behaviors. Self-control is initiated whenever there is a conflict between two or more dominant response tendencies or goals, such as when one's goal of losing weight comes into conflict with one's goal of eating delicious, yet fattening french-fries (Stroebe et al., 2008). Conflict, however, is not an affectively neutral event; rather, it is distressing, laden with anxiety (Gray & McNaughton, 2000). According to the *affect alarm model of self-control* (Inzlicht, Bartholow, & Hirsh, 2013; Schmeichel & Inzlicht, 2013), this anxious distress can be adaptive, acting like a kind of signal that there is a potential for things to go wrong. This distress not only orients people to the kind of conflict that can undermine goal attainment, but, because people are motivated to avoid distress, also motivates people to resolve the conflict effectively. Critically, this distress serves to recruit control *only* to the extent that people are open, curious, and accepting of it; it is only by flexibly accepting their distress that people can hear what the distress is trying to "communicate" and then make necessary behavioral corrections. As with physical and social pain, that is, distress can only recruit adaptive responses (i.e., self-control) when people are sensitive to their own avoidant emotions. To be clear, although distress can recruit a whole host of behaviors (e.g., Proulx & Inzlicht, 2012), it will only lead to accommodative, self-controlled behaviors to the extent that the distress is recognized (even unconsciously) and accepted. According to our model, then, distress is a necessary but not sufficient ingredient of self-control.

By casting distress in a starring role, the affect alarm model of self-control offers an understanding of self-control that provides novel insights into how it is recruited. Given the centrality of self-control to so many domains of life–from marital fidelity to criminal behavior, from financial stability to academic performance (e.g., Baumeister, Heatherton, & Tice, 1994)–it should come as no surprise that a number of different social psychological phenomena seem to affect it. For example, autonomous motivation (Deci & Ryan, 1985), self-affirmation (Steele, 1988), mindfulness meditation (Brown, Ryan, & Creswell, 2007), and incremental theories of intelligence (Dweck, 1999) have all been shown to improve aspects of self-regulation, including self-control. Emerging evidence suggests that these diverse phenomena increase control because they amplify the type of short-lived distress response that we suggest is so crucial to self-control. Further, these phenomena increase control because they also increase an openness to distress, a type of non-judgmental stance that allows people to orient to the source of distress and thus do something about it. In other words, these phenomena short-circuit defensive responding to distressing events and instead foster a sort of openness that could, among other things,

foster effective self-control. By suggesting that these diverse phenomena work through the same dynamic, this may further suggest that these phenomena are not so different after all. We start our chapter by outlining the affect alarm model of control and providing details of the various components of the model.

AFFECT ALARM MODEL OF CONTROL

Historically, when it has come to understanding the will, emotion has been at the bottom of the list. So, the proposition that negative affective states like distress form an integral part of self-control might seem counterintuitive. This is because emotion has long been considered the antithesis of reason, with reasoned action the master and bestial emotion the slave (Solomon, 2008). Contemporary views, however, suggest that emotion and cognition are fully integrated and only minimally decomposable (e.g., Pessoa, 2008), which opens the door to the idea that emotions play a central, integral role in cognition, including higher cognitive functions like executive function or self-control.

Control is Initiated by Conflict

The affect alarm model suggests that self-control is instigated by conflict, by which we mean any disagreement or discrepancy between competing mental representations, response tendencies, or actual behavior (Festinger, 1957). We have already mentioned how the conflict between the goal of losing weight and the desire to eat french-fries can instigate control, but other examples abound: cognitive conflict is aroused when having to choose between two desirable choices, when having to choose between a large reward now and an even larger reward later, when wanting to write a chapter but also wanting to check email, or when needing to name the color of a word but also having the strong urge to read it. Conflict is a common starting point for the process of self-control, with many other models starting similarly. Indeed, converging evidence from cybernetics, animal models, neuroscience, and social and personality psychology suggests that goal and response conflicts act as the instigator of control.

Conflict plays a critical role in cybernetic models of self-control, which suggest that control hinges on a simple feedback-loop process that checks for disagreements between desired end states (i.e., goals) and current states of the environment (Carver & Scheier, 1981; Wiener, 1948). Cybernetic principles have been widely used to model control in the behavior of humans and machines. They have been successful because they emphasize the decision point when self-control is initiated–specifically, when things deviate from what is ideal. What starts self-control, in other words, is the presence and detection of conflict. This type of conflict is present, for example, when a depressed person sets the goal of not ruminating on their thoughts, but catches themselves doing just that. As we will see below, cybernetic models further suggest that this detection of conflict produces an emotional response that expedites the instrumental actions that contribute to control.

According to revised *reinforcement sensitivity theory* (RST; Gray & McNaughton, 2000), goal conflict activates the motivational system that is responsible for the braking or stopping of ongoing behavior, the behavioral inhibition system (BIS). Based on animal models, behavioral neuroscience, and the pharmacological effects of classic and modern pharmacological agents, revised RST suggests that behavior depends on three underlying motivational systems–a system sensitive to reward (the behavioral approach system), another sensitive to punishment (the flight-fight-freeze system), and a third (the BIS) that regulates conflicts that arise within and between the other two systems. BIS can be conceptualized as the control system because when it detects goal conflicts, it overrides or inhibits all ongoing behavior while the organism attempts to resolve the conflict to determine the best course of action. Critically, BIS recruits avoidant-motivated, negative affect and is widely considered as the neural substrate of anxiety. In short, BIS is sensitive to conflict and reacts to it by recruiting anxious phenomenological states that help put the brakes on ongoing behavior to eliminate goal conflict.

Conflict also plays a large role in a prominent cognitive neuroscience theory of control, *conflict monitoring theory* (Botvinick et al., 2001; Yeung, Botvinick, & Cohen, 2004). According to this model, control is implemented by two separate neural systems. The first is described as a system that scrutinizes moment-to-moment mental representations for the presence of conflicting response tendencies (Botvinick et al., 2001) or between what is predicted and what actually happens (Holroyd & Coles, 2002). When conflict is detected, this information is passed to the second, regulatory system, which implements the desired response while suppressing incompatible ones. Neuroimaging studies have suggested that these systems are implemented by the anterior cingulate cortex (ACC) and the dorsolateral prefrontal cortex (DLPFC), respectively (e.g., Kerns et al., 2004; see Denson, this volume). Although not stressed by conflict monitoring theory, increasing evidence suggests that the conflict in conflict monitoring is not affectively neutral, with the neural substrate of conflict detection–the ACC–sensitive to pain, distress, and other negative emotions (Shackman et al., 2011). Much of the evidence we present later in this chapter comes from measures of evoked brain potentials that are widely thought to relate to cognitive conflict, but also to negative affect (e.g., Inzlicht & Al-Khindi, 2012).

Social and personality psychology theories also stress the importance of conflict in instigating control, with some theorists suggesting that the detection of conflict is the "defining feature of self-control phenomena" (Hofmann & Kotabe, 2012, p. 711). For example, effective thought control is believed to rely critically on a monitoring process that scans for thoughts that are inconsistent or in conflict with an intended state (Wegner, 1994). A new model of adaptive control (Shackman et al., 2011) suggests that self-control is initiated whenever there is a high need to determine an optimal course of action, such as when people face uncertainty. And, uncertainty can be conceived as a type of conflict between various competing behavioral and perceptual affordances (Hirsh, Mar, & Peterson, 2012). Critically, while uncertainty involves cognitive calculation, it is fundamentally an aversive experience, which people are motivated to avoid.

Conflict Arouses Avoidant Distress

The affect alarm model suggests that mere conflict is insufficient to motivate control; what is also needed is an affective, aversive, and avoidant response to conflict. Without the heat of emotion, conflicts may go undetected–or they may go unresolved even if detected because of a lack of urgency brought about by the desire to reduce the aversive state. Although not sufficient on its own, aversive affect is necessary for self-control.

Before presenting evidence linking conflict with aversive arousal, it is important to define and discuss a few terms and issues concerning affective processes. We use the broad term "affect" to describe the emotions that may be triggered by conflict. Affective states are multi-faceted, whole-body responses involving changes to subjective experience, physiology, and behavior (Mauss et al., 2005). However, although often assumed, these response systems do not always cohere, which suggests that subjective "feelings" may be dissociated from physiological responses. And, indeed, research suggests that affective states can occur without conscious subjective experience of either the cause of the affect or of the affective state itself (Winkielman & Berridge, 2004). What is more, affect can vary on its speed, with some "full-blown emotions" being slow to rise and slow to dissipate, and other affective states being more like quick twinges that may not be conscious, arising very rapidly, possibly within fractions of a second, and maybe dissipating just as quickly (Zajonc, 1980).

Cybernetic models specify that controlled processing is instigated by the detection of some discrepancy from what is ideal. This detection process, however, may be far from affectively neutral, with the detection of fast-changing discrepancies producing positive affect and slow-changing discrepancies, negative affect (Carver & Scheier, 1990). Critically, while positive affect can sometimes lead to the slackening of goal pursuit, negative affect sometimes hastens goal pursuit and hence discrepancy reduction (Carver & Scheier, 2011). Negative affect, in other words, instigates control by orienting people to the fact that a discrepancy was detected and that discrepancy reduction and hence control are required. It not only orients people to discrepancy, it motivates its reduction because people naturally want to reduce negative affect and maximize positive affect (Freud, 1920/1952). The point here is that feedback-loop models of control posit an important role for negative affect in prompting control. Some animal models do the same.

According to revised RST (Gray & McNaughton, 2000), BIS is not only involved in conflict detection and resolution, but forms the basis of a general anxiety network in the brain. Revised RST suggests that BIS functioning contributes to feelings of anxiety, and may be experienced phenomenologically as worry, caution, and vigilance. Anxiolytic drugs like Valium, Xanax, or Diazepam act on the neural substrates of BIS, most notably the septo-hippocampal comparator system, but also the ACC and the locus coeruleus-norepinephrine system (Gray & McNaughton, 2000). Norepinephrine is a catecholamine neurotransmitter that is associated with attention (Aston-Jones & Cohen, 2005),

but also with alerting, sensory arousal, and anxious distress (Panksepp, 1998). For example, single-cell recording studies suggest that norepinephrine neurons in the locus coeruleus (in the brain stem) are sensitive to emotional stressors (Abercrombie & Jacobs, 1987). The release of norepinephrine thus appears to be one of the key processes in the cascade of neural activity underlying anxiety, and a vital part of the conflict-detecting BIS.

Further evidence for conflict's aversive nature comes from work on the error-related negativity (ERN), a negative voltage deflection in the event-related brain potential that peaks around 100 ms after error and is thought to be generated by the ACC (Dehaene, Posner, & Tucker, 1994; Gehring et al., 1993). Although widely assumed to reflect the cold detection of conflict (e.g., Denson, this volume), recent work suggests that the ERN may also reflect an emotional, distressed response to errors (e.g., Inzlicht & Al-Khindi, 2012; Luu, Collins, & Tucker, 2000). The ERN, as the name implies, is time-locked to errors, and errors are typically distressing. Errors, for example, prompt increased skin conductance, greater heart rate deceleration, increased pupil dilation, and larger startle reflexes compared with correct responses (Critchley et al., 2003; Hajcak & Foti, 2008; Hajcak, McDonald, & Simons, 2003). The ERN may thus reflect not only the detection of an error but also the aversive affect that accompanies such detection. This may be why the ERN not only predicts improved cognitive performance (Hirsh & Inzlicht, 2010), but also individual differences in negative affectivity, including anxiety disorders (Hajcak, McDonald, & Simons, 2004). Findings such as these hint at the possibility that distressed affect plays a key role in linking the detection of conflict and instrumental behaviors to resolve the conflict.

Basic research in social psychology further confirms the distressing nature of cognitive conflict. Cognitive dissonance (Festinger, 1957) is a term used to describe the feelings of discomfort when simultaneously holding in mind two or more conflicting thoughts, or two or more action-tendencies (Harmon-Jones & Harmon-Jones, 2008). Although there was once a dispute as to the nature of dissonance (e.g., Bem, 1967), most researchers now agree that dissonance is fundamentally distressing (e.g., Croyle & Cooper, 1983; Proulx, Inzlicht, & Harmon-Jones, 2012; Zanna & Cooper, 1974) with people actively motivated to reduce its presence and effects. Moreover, brain findings suggest that dissonance evokes activity in the ACC (Kitayama, Tompson, & Chua, this volume), which, as we have mentioned above, is implicated in pain, negative affect, and cognitive control (Shackman et al., 2011). In sum, while conflict prompts control, many lines of evidence suggest that conflict is distressing. The affect alarm model suggests that conflict initiates control via its effects on these aversive states.

Distress Recruits Control

The affect alarm model suggests that control is instigated by the presence of conflict that arouses aversive affective states. It further suggests that these states of distress (1) alert people to the presence of conflict and (2) motivate actions to reduce the distress, including resolving the conflict itself.

One reason aversive affect helps recruit control is that affect, both avoidant and appetitive, is especially likely to influence attention and mobilize the organism for action (Bradley et al., 2001). This is why emotional stimuli are viewed for longer than neutral pictures (Lang, Bradley, & Cuthbert, 1997), are associated with extremely fast electrocortical responses reflecting visual attention (Harmon-Jones, Harmon-Jones, & Price, this volume), and can intrude into attention when attentional resources are otherwise occupied (Most, this volume). Emotional stimuli preferentially capture attention because they typically signify the presence of something motivationally relevant or salient (Hajcak et al., 2012). This may be why some affects (e.g., negative moods) lead to controlled responding and a reduced reliance on superficial cognitive heuristics (Forgas, this volume).

Emotions exist to signal states of the world that have to be responded to; they help prepare an organism for effective action (Izard, 2010). That is, they orient people to the motivationally salient aspects of their environments and drive intelligent behaviors (Damasio, 1994). Thus, when the goal conflict faced by a dieter arouses anxious distress, this aversive state not only helps her attend to the presence of conflict, it also helps her prepare for actions to reduce this aversive state. People are typically motivated to avoid distress, which may be why people tend to respond to distressing events by taking actions to diminish them.

As we have already mentioned, cybernetic models place great importance on the detection of conflict as the decision point that gets control started. When conflict is detected this feeds forward to the motor of control that labors to reduce conflict. Critically, when the rate of conflict reduction is below some internal criterion, this produces negative affect that acts to hasten the rate of conflict reduction by feeding-back and pumping the motor of self-control (Carver & Scheier, 1990). Similarly, BIS responds to goal conflict by recruiting anxious states of distress that help put the brakes on ongoing behavior so that an organism can quickly determine the optimal course of action. BIS, that is, functions to resolve goal conflict by inhibiting or overriding movement toward goals, by increasing states of arousal to allow for split-second changes in behavior, and by increasing attention via environmental scanning or other forms of risk assessment (Gray & McNaughton, 2000).

Cognitive neuroscience models of control suggest that the output of the conflict monitoring system is to inform control centers in the brain, especially the DLPFC, when to execute behavior (Botvinick et al., 2001). And there is an abundance of evidence that this conflict system–which is often measured by the ERN and is intricately related to distress (Hajcak & Foti, 2008)–reliably predicts self-control. This includes research linking the ERN with low-level indices of control, such as the degree to which participants slow down and recalibrate after making an error on a speeded reaction-time task (Bartholow et al., 2012) or the frequency of errors on a test of executive function (Inzlicht & Al-Khindi, 2012); but, it also includes research linking the ERN to higher-level indices of control such as better control of racist impulses (Amodio, Devine, & Harmon-Jones, 2008), better grades in college (Hirsh & Inzlicht, 2010), and better emotion-regulation in daily life (Compton et al., 2008).

Moderating the Affect Alarm: Emotion Acceptance

Whether the affect alarm instigates self-control depends critically on questions about whether the signal is heeded. In other words, negative affect is not enough to recruit control. What is also needed is a sensitivity and receptivity to the aversive affective state. When people are sensitive to the emotions they experience and open-minded about those experiences, they not only have the power to make the correct attribution of what instigated the emotion, they can also accept and "hear" the information conveyed by the emotion.[1] While a number of emotion-related factors may moderate the affect alarm, the one we focus on here is emotion acceptance.

We suggest that the efficiency of the affect alarm is increased when people respond to their emotions with an attitude of openness, curiosity, and acceptance. Thus, simply being aware of one's emotions is not enough; what is also needed is an accepting, flexible, and non-judgmental stance towards those emotions (Cardaciotto et al., 2008; Kashdan & Rottenberg, 2010). People who can experience their affective states–especially aversive ones–without defense, judgment, or a desire to escape them, can "hear" the information the emotion is trying to convey about their current situation, even when those emotions are very fast and very subtle. These sorts of people are receptive to their affect, and when the affect signals the presence of goal conflict, they can then act on them by recruiting instrumental control. In contrast, people who avoid or suppress their negative affect will be unable to use this information to motivate subsequent action. To be clear, while people who are receptive to their affects will become less distressed by them in the long run, they will also become better informed as to the source of their distress and thus better able to engage in actions to reduce this distress, namely the control of their behavior. New research is now beginning to confirm this very idea.

UNIFYING DIVERSE PSYCHOLOGICAL PHENOMENA

The idea that the acceptance of distress promotes self-control by underscoring and rectifying response conflict is central to the affect alarm model of self-control. In line with this premise, the model predicts that a number of seemingly diverse psychological phenomena should promote emotional agility in the service of optimizing performance. In particular, we suggest that autonomy, self-affirmation, mindfulness meditation, and a growth-oriented mind-set all increase self-control by enhancing openness and responsiveness to errors, conflict, and threat. In other words, the acceptance of negative affect provides a mechanism through which these various phenomena elicit their effects on self-control.

Autonomy Boosts Self-Control through the Integration of Experience

The experience of autonomy, which involves feelings of self-direction and volition (as opposed to feeling pressured or coerced), is critically linked to

self-regulation. For instance, autonomy predicts adherence to weight loss programs (Williams et al., 1996), likelihood of quitting smoking (Williams et al., 2009), alcohol abstinence (Ryan, Plant, & O'Malley, 1995), and compliance with pharmacological treatment for disease (Williams et al., 2009). At a lower level of analysis, autonomy has recently been shown to predict better performance on tests of cognitive control (Legault & Inzlicht, 2013).

One key finding that can explain the link between autonomy and self-control is that autonomy promotes openness and integration of ongoing experience. One feels autonomously motivated when one is engaged in an activity that is either interesting or personally important. In contrast, externally-coerced individuals' sense of self is socially-defined and their self-worth is contingent upon social standards. Because of this focus on authenticity, those who function autonomously are accuracy-motivated, maintaining openness and responsiveness to reality, whereas externally-coerced individuals are directed by contingencies of self-worth and defensiveness (Hodgins & Liebeskind, 2003).

In addition to increasing self-awareness (Deci & Ryan, 1985), autonomous motivation also promotes the acknowledgment and acceptance of negative affect, criticism, personal shortcomings, and threatening self-relevant information (Weinstein, Deci, & Ryan, 2011). In contrast, externally-coerced individuals tend to accept positive personal attributes and behaviors while rejecting and denying negative ones. In line with the affect alarm framework, we suggest that it is precisely because of this openness to negative experience and feedback that autonomous motivation promotes self-control. Because an autonomous motivational orientation is task-focused rather than ego-involved, there exists a drive to perceive information accurately and honestly in order to learn and grow.

Self-Affirmation Boosts Self-Control by Reducing Defensiveness

Self-affirmation refers to behavioral or cognitive events that sustain the perceived integrity of the self (Sherman & Cohen, 2006; Steele, 1988). When integrity is threatened (i.e., when one encounters information that undermines the competence or goodness of the self), people may respond by denying or minimizing the threatening information through defensive reactions. But, through the process of self-affirmation, threats to integrity can be managed in an adaptive way that preserves self-worth and also promotes accurate responsiveness to threats (Sherman & Cohen, 2006). This process often involves simple reminders of important aspects of the self (e.g., one's deeply held values). By affirming integrity in this way, one's sense of self becomes secured in one's broader view of the self as good, and there is less need to defend against the threat. Like autonomous individuals, self-affirmed people can focus on the demands of the situation, setting aside the need to protect their ego.

We suggest that self-affirmation improves self-control in much the same way as autonomy; that is, self-affirmation enhances self-control by lowering defenses against potential self-threat. Past work has shown that self-affirmation

eases the impact of negative feedback, such that self-affirmed individuals shed defensiveness in favor of more candid and impartial responses. For instance, whereas people typically tend to resist threatening health-related information, self-affirmation has been shown to increase the acceptance of such information, facilitating awareness of potential health risks, and promoting contemplation of their personal implications (Sherman, Nelson, and Steele, 2000). Not only does self-affirmation lower defensiveness, it also improves self-control, including pain tolerance, task persistence, and delay of gratification (Schmeichel & Vohs, 2009). In line with the affect alarm framework, it appears that self-affirmation promotes openness to threat, and that such openness improves functioning–including task performance–by boosting attention to sources of threat in order to correct future behavior (Legault, Al-Khindi, & Inzlicht, 2012).

Mindfulness Meditation Boosts Self-Control by Increasing Emotional Acceptance

Practitioners of meditation are taught to attend to all thoughts, sensations, and feelings, but also to receive these experiences in a non-judgmental way. Indeed, both present-moment awareness and mindful acceptance of emotional states are fundamental principles of mindfulness meditation practice (Cardaciotto et al., 2008). Mindfulness is a state of *being* in which receptiveness to internal and external stimuli is paramount. This is quite distinct from common forms of processing, which fall prey to cognitive distortions such as attributions, judgments, appraisals, and rationalizations.

Because meditators invest such effort and focus on openly perceiving as well as attentively monitoring emotional experience, it is not surprising that they also show superior self-control. It has been shown, for instance, that experienced meditators excel at conflict monitoring on the Attention Network Test (Jha, Krompinger, & Baime, 2007). As a dispositional trait, mindfulness enhances behavior regulation, psychological health, and interpersonal relationships (Brown et al., 2007). It has also been found that trait mindfulness is positively associated with autonomous self-regulation and congruence between implicit and explicit affect (Brown & Ryan, 2003). It also reduces impulsive responding (Wenk-Sormaz, 2005) and promotes tolerance of distressing emotional states, such as anxiety and fear (Eifert & Heffner, 2003). In line with the affect alarm model of control, we suggest that it is because mindfulness facilitates openness to negative emotion and self-threat (e.g., Brown et al., 2008), that it allows people to connect with their mistakes and shortcomings, thus granting them the ability to attend to and resolve the sorts of goal conflicts that precede self-control.

Incremental Theorists See Negative Feedback as Opportunity

Dweck's model of implicit theories of intelligence (Dweck, 1999) distinguishes between individuals who believe that intelligence is unchangeable

and stable (i.e., *entity theorists* or those who have a *fixed mind-set*) and those who believe intelligence is malleable and can be developed incrementally through learning (i.e., *incremental theorists* or those who have a *growth mind-set*). Relative to entity theorists, incremental theorists focus more on learning goals than performance goals (Dweck & Leggett, 1988) and tend to make mastery-oriented rather than helplessness attributions for failure (Henderson & Dweck, 1990). These two ways of thinking about intelligence have important consequences for performance, achievement, and self-control. Various studies have suggested that those with an incremental view of intelligence demonstrate better academic performance than those with an entity view (Blackwell, Trzesniewski, & Dweck, 2007). Similarly, relative to those with a fixed mind-set, those with an incremental view demonstrate superior executive control, as demonstrated on tests of processing fluency (Miele & Molden, 2010).

Much like autonomous, self-affirmed, and mindful individuals, incremental theorists display adaptive responses to failure. Whereas entity theorists view failure as an indication of their own immutable lack of ability and tend to abandon tasks when they fail at them, growth-minded incremental theorists see failure as potentially instructive feedback and are more likely to learn from their mistakes (Dweck, 1999). This may be because incremental theorists are likely to interpret their shortcomings and difficulties as signs that their knowledge and abilities are still developing (Blackwell et al., 2007). Instead of shrinking at errors, incremental theorists view them as part of the growth process. Consistent with the affect alarm model of control, then, incremental mindsets may improve performance, including on self-control tasks, because they allow people to adaptively respond to errors in order to learn and grow from them.

A NEURAL BOTTLENECK FOR DIVERSE PHENOMENA

An important mechanism underlying each of the aforementioned psychological phenomena is an attitude of openness and acceptance to errors and personal shortcomings. When people accept their mistakes, see them as opportunities to learn, they may become more attuned and sensitive to them. Part of this increased sensitivity includes "experiencing" the sorts of upticks in short-lived emotion that (1) orient people to the fact that a mistake was made and (2) that motivate the kinds of behaviors that lead people to avoid such mistakes in the future. Indeed, recent evidence suggests that brain-based responses that reflect both the detection of error and the short-lived affect that accompanies such detection help to explain the effects of autonomy, self-affirmation, mindfulness, and learning orientation on self-control. In particular, the ERN–which, as previously stated, may reflect the detection of and emotional response to conflict (Inzlicht & Al-Khindi, 2012)–appears to mediate the effects of each of these psychological states.

Autonomy and the ERN

Recent work has shown that both trait-level and state-induced autonomy are linked to the ERN (Legault & Inzlicht, 2013; see also Amodio et al., 2008). When those high and low in autonomy completed either a Go/No-Go or Stroop task while ERN amplitudes were recorded using electroencephalography, those high in autonomy showed greater self-control (i.e. fewer errors) and a higher ERN. A test of mediation further revealed that the ERN accounted for the link between autonomy and self-control. Thus, as autonomous motivation increased, the ERN increased as well, which was related to increases in performance.

Self-Affirmation and the ERN

Self-affirmation also increases the ERN (Legault, Al-Khindi, & Inzlicht, 2012). Participants in one study were assigned to either a self-affirmation or non-affirmation condition. Those who asserted their core values, that is, those who engaged in self-affirmation, demonstrated larger ERNs on a subsequent Go/No-Go test than did non-affirmed participants. They also performed better on the test, as evidenced by fewer errors. As this study reveals, affirmation of core values appears to lower defensiveness towards errors, thereby attuning people to these errors so that they can be prevented in the future.

Mindfulness and the ERN

Teper and Inzlicht (2013) have recently shown that mindfulness also predicts ERN amplitudes. When mindfulness meditators and community-matched control participants completed a Stroop task (during which their ERN amplitudes were recorded), meditators showed greater self-control (i.e. fewer errors), as well as higher ERNs. Moreover, meditators showed greater emotional acceptance than did controls. A test of mediation revealed that the link between meditation practice and self-control was explained by both emotional acceptance and heightened brain-based detection of and emotional-response to errors (i.e., the ERN). By increasing acceptance, in other words, meditation leads people to become more attuned to their errors, including experiencing more error-related emotionality, and this then fosters better self-control.

Learning Orientation and Error Positivity

Finally, recent work has shown that having a growth mind-set is associated with enhanced error positivity (Moser et al., 2011). Error positivity (Pe) is a later occurring event-related-potential component, appearing after the ERN on error trials and is thought to represent awareness and allocation of conscious attention to mistakes (Nieuwenhuis et al., 2001). Like the ERN, the Pe plays a role in on-line error monitoring, and correlates with adaptive behavioral adjustments following errors (Hajcak et al., 2003). Moser and colleagues (2011)

demonstrated that incremental theorists performed better on a flanker task compared to entity theorists, likely because they interpreted mistakes as "growing pains" rather than evidence of failure. More to the point, the Pe mediated the relationship between mind-set and performance, underlining the idea that the awareness of errors, which may include emotional responses to errors, increases the ability to rebound from mistakes.

Summary

The above studies indicate that autonomy, self-affirmation, mindfulness, and learning orientation are all related to better self-control. We suspect that these varying phenomena improve self-control because they increase acceptance and non-defensiveness, which may translate to greater awareness of errors and mistakes. Critically, this awareness may be abetted by very brief emotional twinges that orient people to the fact an error was made. And this is one thing we may be measuring with the ERN.[2]

DISCUSSION

Although negative affect is painful and counterproductive in large doses, it serves a vital function in self-control. Without it, people would not know when self-control efforts were lacking and when behavior is in need of correction. Negative affect is thus an adaptive feedback signal that accompanies deficiencies in goal progress and thereby drives optimal performance. However, it is not simply the presence of affect that instigates this reactive form of self-control. The capacity to detect and accept it is just as important.

Despite the significant intersection of negative affect and adaptive functioning, we are mindful not to overstate the benefits of distress. Here, we are referring to the functional role of transient negative affect rather than the debilitating effects of prolonged or full blown negative emotions. We certainly do not suggest that negative emotions are conducive to goal regulation or wellness in general, especially if they are chronic (see Inzlicht et al., 2013). Indeed, pervasive negative emotions, such as would occur for people high in trait anxiety, often undermine self-control (Eysenck et al., 2007) despite producing higher ERNs (Gehring, Himle, & Nisenson, 2000; Hajcak et al., 2004). Negative emotion and amplified ERNs, then, are not sufficient to produce better self-control. Instead, we are suggesting that it is attention to and acceptance of phasic changes in affect that are integral to the dynamic regulation of action. And it is negative affect, in particular, that signals when attention is most needed.

CONCLUSION

The main contribution of the affect alarm model of self-control is to suggest that aversive affect plays an instrumental role in recruiting self-control. Affect, according to our model, is not merely an interloper that moderates control from

the outside, nor is it merely an object or product of self-control. Rather, it is essential to self-control, signaling when it is needed by amplifying the detection of conflict and giving urgency to conflict resolution. Thus, the central aim of this chapter was to highlight the integral role of negative affect in instigating and motivating control.

This chapter also highlights the power of neuroscience to unite seemingly diverse phenomena. Because social neuroscience reduces social psychological phenomena to a core set of functions and mental modules, it reveals links between otherwise distinct phenomena. The finding that autonomous motivation, self-affirmation, mindfulness meditation, and incremental mindsets all foster better control coupled with the finding that they each foster control because of their respective impact on the brain-mediated detection of and emotional response to errors and conflict suggests that these phenomena may not be so different after all. Rather, these phenomena fall under the same mechanistic umbrella, namely they each defuse defensive responding to distressing events–including to goal conflict–and instead nurture a sort of acceptance that fosters effective self-control. Future work should identify other phenomena that can increase acceptance because in so doing they may identify phenomena that can also increase control.

NOTES

1 This sensitivity and acceptance of affect can happen below levels of conscious awareness. That is, people who are skilled with emotion may non-consciously recognize and accept their various affective states, even those states that are non-conscious and very fast.

2 It is important to note that there is no one-to-one relationship between the ERN and emotion and that any connection with the above phenomena and the ERN may thus be due to other non-emotional factors as well (e.g., error detection). Future studies are therefore needed to confirm the emotional interpretation that we prefer.

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